Decoupling of soil water and stream water is critical for solving global hydrologic fluxes

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Abstract

Resolving the global transpiration flux is critical to constraining global carbon cycle models because carbon uptake by photosynthesis in terrestrial plants (Gross Primary Productivity, GPP) is directly related to water lost through transpiration. Quantifying GPP globally is challenging (1) because GPP can only be measured directly at the leaf level. The Tropospheric Emissions Spectrometer (TES) is providing new and exciting spatially explicit data on hydrogen water isotopes that are opening up new methods for resolving global hydrologic fluxes (2). Using these data, Good et al. (3) estimate the median global value for plant transpiration (T) to be 48% of continental precipitation, while 26% returns to the oceans as streamflow (Figure 1). The remainder is evaporation (E) from the following components: interception by plant canopies (20%), soils (4.3%) and surface waters (1.7%). They estimate transpiration/evapotranspiration (T/ET) as 64%, which is comparable to the median value of 61% from the limited field datasets where transpiration and evaporation are actually partitioned (4). By adding the global water isotopic constraints to the hydrologic fluxes, Good et al. (3) dramatically narrowed the potential range of T/ET, and thus the range for GPP. Using the simple assumption that, on average, plants lose ~300 molecules of H_2O for every CO_2 molecule captured by photosynthesis, their transpiration estimate (55,000 km^3/yr) would equate to approximately 120 Pg C/yr for GPP, which is similar to modeled estimates (1, 5, 6). Future work will likely integrate these hydrologic isotopic data with the global isotopic tracers of CO_2 to resolve these fluxes simultaneously.